

V. NOTES ON ORDOVICIAN TRILOBITES. IV.

NEW AND OLD SPECIES FROM THE CHAZY.

BY PERCY E. RAYMOND.

Since my article on the "Trilobites of the Chazy Limestone" was published in these ANNALS, Vol. III, 1905, a number of new species and new facts about old species have come to light, making it possible to add to and correct the previous article in a number of ways. The material on which the present article is based is in two collections, one made for the Carnegie Museum by the writer in 1905 and 1906, and the other a small but very important collection from Isle La Motte, made and submitted by Professor George H. Perkins, State Geologist of Vermont. The latter collection forms the basis of an article which will appear in the next report of the State Geologist of Vermont, but Professor Perkins has very generously permitted me to describe the new material at this time. My thanks are due him the more as he had intended describing these forms himself, but he has, with great unselfishness, turned them over to me.

ARTHROPODA.

Subclass Trilobita.

ORDER *Hypoparia* Beecher.

Genus *Eoharpes* Raymond.

Eoharpes antiquatus (Billings).

The writer has shown elsewhere that the name *Harpina* was preoccupied when used by Novak, and the name *Eoharpes* was suggested to take its place.¹

ORDER *Opisthoparia* Beecher.

Family *OLENIDÆ* Salter.

Genus *REMOPLEURIDES* Portlock.

Remopleurides canadensis Billings.

The thorax and pygidium of this species are very much like those of *Remopleurides salteri* var. *girvanensis* Reed from the Llandeilo of the

¹*American Journal of Science*, Series 4, XIX, 1905, 377.

Girvan District. The whole structure of the free cheeks,² thorax, and pygidium is very different from that of *Caphyra radians* Barrande and *C. striatulus* Walcott.

Family ASAPHIDÆ Emurich.

It is difficult to subdivide this family satisfactorily, but there are a few facts that can not be overlooked in the classification of the genera. The character of the hypostoma separates two great groups, one including those forms with an entire hypostoma, while in the other group the hypostoma is forked. Geologically, the forms with the entire hypostoma are the more ancient, and this group includes the species in which the lobation of the glabella and the segmentation of the pygidium are most marked. It is in this group also that the anterior limb of the facial suture is generally marginal, while in the group with forked hypostomas the anterior limb of the suture is generally on the dorsal surface. In both groups there is a tendency for the glabella to become flat and to merge into the general contour of the cephalon. The glabellar furrows become faint and finally obsolete, the axial lobe of the thorax becomes broader, and the ribs on the pygidium tend to disappear, giving the whole animal a smooth upper surface. This "smoothing out" reaches its culmination in *Nileus* among the more primitive forms, and in *Isotelus* in the other group. Of the first group only *Vogdesia* survives as late as the Black River, the earlier forms appearing in the Cambrian. The earliest member of the second group now known appears (in America) in the Upper Beekmantown, and the subfamily is very abundantly represented in the Chazy, Black River, and Trenton, continuing throughout the Ordovician.

Subfamily OGYGINÆ nov.

Asaphidæ with hypostoma entire and eight segments in the thorax.

Section 1. *Ogyginæ* with anterior limb of facial suture marginal. *Ogygia*, *Niobe*, *Asaphellus*, *Symphysurus*, *Nileus*, *Vogdesia*, *Illænurus*.

Section 2. *Ogyginæ* with anterior limb of suture intra-marginal. *Megalaspis*, *Megaaspides*.

Subfamily ASAPHINÆ nov.

Asaphidæ with hypostoma forked.

Section 1. *Asaphinæ* with anterior limb of facial suture marginal. *Basilicus*.

²The Lower Paleozoic Trilobites of the Girvan District, Ayrshire, pt. I, 1903, 39, pl. 6, figs. 11-14.

Section 2. *Asaphinæ* with anterior limb of suture intra-marginal. *Ptychopyge*, *Pseudasaphus*, *Asaphus*, *Onchometopus*, *Isotelus*, *Isoteloïdes*.

Genus *BASILICUS* Salter.

This genus includes the most primitive of the Asaphids with fringed hypostomas. The pygidium is strongly annulated, the glabella retains some of the glabellar furrows, the genal angles are spine-bearing, and the facial suture is marginal in front. Many of the species usually referred to *Ptychopyge* belong to this genus. Only three species are known in America, these being *Basilicus marginalis* (Hall) of the Chazy, *B. romingeri* (Walcott) of the Black River, and *B. canadensis* (Chapman) of the Utica. As figured, *Asaphus canadensis* would be a *Ptychopyge*, but the writer has examined numerous specimens in the Museum of the Geological Survey of Canada without finding a single specimen showing an intra-marginal suture.

Basilicus marginalis (Hall).

Plate XVII, figure 6, Plate XIX, figures 1, 2.

Asaphus marginalis HALL, Paleontology New York, I, 1847, 24, pl. 4bis, fig. 15.

—EMMONS, American Geology, I, ii, 1855, 235, pl. 3, fig. 16. —RAYMOND, Annals Carnegie Museum, III, 1905, 339, pl. 10, figs. 17-20; pl. 11.

Asaphus alpha RAYMOND, Annals Carnegie Museum, III, 1905, 342, pl. 12, fig. 9.

Asaphus gamma RAYMOND, Annals Carnegie Museum, III, 1905, 342, pl. 12, fig. 10.

This species is closely allied to *Basilicus tyrannus* (Murchison), and the character of the facial suture, the glabellar furrows, and the great number of ribs on the pleura of the pygidium show that it should be referred to *Basilicus*.

The shape of the distal end of the pygidium is still in doubt. The accompanying text figure is from a large specimen in the Yale University Museum. The lobes at the side are due to the fracture of the shell, but the posterior lobes, which are not strictly symmetrical with respect to the axis of the pygidium, are natural.

In the crystalline limestone at McCullough's sugar-bush at Chazy the pygidia described as *Asaphus alpha* in my previous paper are quite common, and with them occur cranidia of small size which have the surface marked by very numerous fine granulations. This is the peculiar surface which characterizes *Basilicus marginalis*, and distinguishes it at once from all the other Asaphids of the Chazy. The cranidia are very small, from 1.5 to 3 mm. in length. The glabella is depressed convex, definitely outlined, with three pairs of shallow glabellar furrows. In front of the glabella there is a wide flattened border which is crossed by a narrow ridge,

as in adult specimens of *B. marginalis*. From these characters it is believed that the small specimens called *Asaphus alpha* and *gamma* in my previous paper are really only the young of *marginalis*. No adult specimens of *B. marginalis* have been found with these small specimens by the writer, but Hall's type was from the "crystalline and highly fossiliferous mass of the Chazy limestone, below the portion containing *Maclurea magna*, at Chazy village," a description which exactly fits the layers from which these minute specimens were obtained.

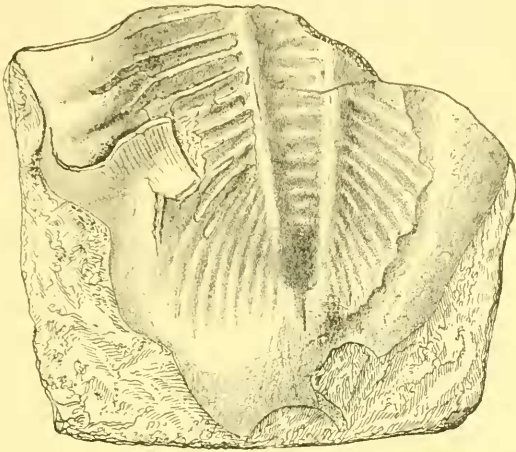


FIG. 1. *Basilicus marginalis* (Hall). A pygidium, natural size, showing lobes at the posterior end.

It will be noted that these specimens correspond in many respects with the minute trilobite described by Clarke as *Gerasaphes ulrichana* (Paleontology Minnesota, Vol. III, pt. II, p. 710, figs. 14-16). The lobation of the glabella is not the same, however, and Dr. Clarke states that the surface of his specimens is smooth, not granulated. The specimens recorded as *Gerasaphes ulrichana* by Ruedemann (New York State Museum, Bulletin 49, 1901, p. 6) may well have been the same as the ones here described, as there were a few Chazy species in the pebbles at Rysedorph Hill.

Genus ASAPIUS Brongniart.

Subgenus ONCHOMETOPUS Schmidt.

In erecting the subgenus *Onchometopus* for his species *volborthi*, Schmidt placed a special emphasis upon the hooked character of the doublure of the front of the cephalon, but there are other peculiarities which make

the term a useful one. The axial lobe is somewhat wider than in *Asaphus* and the glabella is much smoother than in that genus. The form of the trilobites to which this term is applied is much like that of *Isotelus*. In fact, the parallelism is so close that the differences may not be evident to many persons until they have examined well preserved specimens. The close relationship to *Asaphus* is at once revealed by the absence of a concave border on cephalon and pygidium. Beside the *Onchometopus* of the Chazy, the subgenus is represented in America by *O. simplex* Raymond and Narraway of the Black River, and *Asaphus susæ* Whitfield and *Asaphus alcer* Billings of the Cincinnati.

Onchometopus obtusus (Hall).

Plate XVIII, figures 2, 3, 4.

Asaphus ? obtusus HALL, Paleontology New York, I, 1847, 24, pl. *abis*, fig. 14.

Isotelus obtusus RAYMOND, Annals Carnegie Museum, III, 1905, 344, pl. 12, figs.

I, 2.

This species, which can now be more fully described from a nearly complete specimen sent by Professor Perkins, should be removed to the genus *Onchometopus*, the most striking generic character being the absence of a channeled border on the cephalon and pygidium.

DESCRIPTION.

Entire animal oval in outline, rather broad and only slightly convex. The entire test is very coarsely punctate, making the identification of the species easy.

Cephalon nearly semicircular in outline, being about one-half as long as wide. It is gently and regularly convex, and lacks the depressed or concave border seen in the associated *Isotelus harrisi* and *Isoteloides angusticaudus*. The glabella is faintly defined, nearly smooth, three pairs of very shallow furrows being visible on the cast. The neck-furrow is shallow, and hardly visible on the free cheeks. Just in front of it is a small median tubercle. The eyes are small and are situated about their own length in front of the posterior margin. Free cheeks with rounded genal angles.

The thorax has eight rather broad flat segments which are abruptly deflected at the sides. The median lobe is about one-third the total width of the thorax, being wider than in *Asaphus* and less wide than in *Isotelus*. In figure 1, of Plate XII, of my previous article the axial lobe

is represented as wider than it really is, the correct proportions being given in the text.

Pygidium two-thirds as long as wide, uniformly convex, without channeled border. Axial lobe broad at the anterior end, tapering rapidly, and becoming obscure on the middle of the pygidium. On the cast it is more prominent. There are no traces of segments on the axial lobe or on the pleura.

Locality.—This species is most common in the upper part of the Chazy, but it has been found in all portions. Specimens have been obtained at Crown Point, Valcour Island, Plattsburgh, and Chazy, New York, and on Isle La Motte, Vermont.

Genus ISOTELUS Dekay.

Isotelus harrisi Raymond.

Plate XVII, figure 1.

Isotelus harrisi RAYMOND, Annals Carnegie Museum, III, 1905, 343, pl. 12, figs. 3, 5-7; not fig. 4.—SCHMIDT, Memoirs of the Imperial Academy of Sciences of St. Petersburg, XX, 1907, 75.

Specimens of *Isotelus* are abundant in the collection made by Prof. Perkins, and it appears that there are two species in the buff dolomite of the reef at the base of the Upper Chazy. The cranidium figured on Plate XII, figure 4, of my previous paper does not belong to *Isotelus harrisi*, but to a new species which is described in this paper. The cranidium of

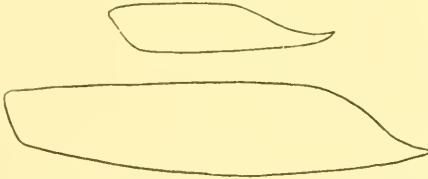


FIG. 2. Upper figure. *Isotelus platymarginatus*. Lower figure. *Isotelus harrisi*. Profiles of pygidia of the two species, one-half natural size, to show the much wider border of *I. platymarginatus*.

Isotelus harrisi has a short broad form, is very wide between the eyes, and the eyes are situated far forward. The portion of the cranidium in front of the eyes is evenly convex, and not depressed as in the new species. The pygidium of *I. harrisi* is also wider in proportion to the length than in *I. platymarginatus*, the concave margin is narrower, and the posterior end of the axial lobe is much more prominent. The cephalon of this species

is quite different from that of the typical *Isotelus*, being shorter and more evenly convex, and the hypostoma, as pointed out by Schmidt, differs markedly from the typical form in having a constriction at the front.

DESCRIPTION.

Cephalon short, wide, gently convex, with a narrow concave border in front. The eyes are situated nearly half-way to the front, and very far apart. Dorsal furrows broad and shallow, extending to the palpebral lobes. Glabella not defined, and glabellar furrows absent. Free cheeks large, with strong spines at the genal angles.

Thorax of eight flat segments, the axial lobe a little more than one-half the total width.

Pygidium broader than long, with rounded outline. It is strongly convex, with a steep, concave border. Axial lobe wide at the anterior end, scarcely defined by dorsal furrows, but rather prominent at the posterior end. There are very slight traces of rings and ribs.

Length of a cranidium in the collection of the Geological Survey of Vermont, 65 mm.; width between eyes, 50 mm.; back of eyes 19 mm. from the posterior border of the cephalon. These measurements correspond rather closely with the measurements of a cranidium from Valcour Island given in the original description. The type pygidium is 67 mm. long and 95 mm. wide. One of the pygidia from Isle La Motte is 85 mm. long and 125 mm. broad.

Locality.—This species is found at Crown Point, Valcour Island, Chazy, and Cooperville, New York, and on Isle La Motte, Vermont.

Isotelus platymarginatus sp. nov.

Plate XVII, figures 2-5; Plate XIX, figure 3.

Isotelus harrisi RAYMOND, Annals Carnegie Museum, III, 1905, pl. 12, fig. 4.

Associated with the preceding there is a smaller and more typical *Isotelus*. This species has a nearly circular pygidium, the concave border is very wide and almost flat, and the eyes are situated well back on the cephalon and are not farther apart than in *Isotelus gigas*. In the collection made by Prof. Perkins is a natural mould of a small but nearly complete specimen.

DESCRIPTION.

Cephalon gently convex, with a wide concave border. The cranidium is depressed in front of the eyes, the glabella smooth, not defined, glabellar furrows absent. Eyes large, situated a little more than their own

length in front of the posterior margin of the cephalon. Free cheeks drawn out into spines which extend back to the middle of the thorax.

Thorax of eight segments, the axial lobe slightly less than one-half the total width.

Pygidium subcircular in outline, gently convex, with a wide flattened border. The axial lobe is very obscurely defined.

The best specimen was, when entire, about 50 mm. long. The pygidium is 18 mm. long and 22 mm. wide; the thorax 16 mm. long and the median lobe is a little less than one-half the total width (.45). A larger pygidium in the Carnegie Museum is 46 mm. long and 52 mm. wide.

This species differs from *Isotelus gigas* in having a subcircular instead of a subtriangular pygidium, and in having longer genal spines. In some ways it is like *Isoteloides whitfieldi* of the Beekmantown, but the axial lobe is wider, the cephalon lacks the median tubercle, and the glabella is not defined as in that species.

Locality.—This species occurs in the buff dolomite of the reefs at the base of the Upper Chazy on Valcour Island, New York, and on Isle La Motte, Vermont. The mould of the nearly complete specimen is in the collection of the Geological Survey of Vermont, and the large pygidium figure is in the Carnegie Museum.

Isotelus beta Raymond.

Plate XIX, figures 4-7.

Asaphus beta RAYMOND, Annals Carnegie Museum, III, 1905, 342, pl. 12, fig. 9.

The little pygidia called *Asaphus beta* in my previous paper are very abundant at McCullough's sugar bush at Chazy, and are there associated with cranidia and free cheeks of an *Isotelus* of corresponding size. These little trilobites agree with *Isotelus harrisi* in having the eyes rather far forward, but the cranidium is not so short and wide as in that species. The pygidia are less broadly bordered and the genal spines are shorter and less flattened than in *Isotelus platymarginatus*. The name *beta* is therefore retained for the present. The thorax is unknown.

GENUS ISOTELOIDES Raymond.

This genus was proposed in a previous article in this number of these ANNALS for trilobites with the smooth form and concave borders of *Isotelus* but with a narrower axial lobe, a somewhat definitely defined glabella, and an *Asaphus*-like hypostoma. The type is *Asaphus canalis* as described by Whitfield (*Isoteloides whitfieldi* Raymond). *Isoteloides*

homalnotoides (Walcott) and the species here described are not exactly similar to the type-species, but they seem to fit in this genus better than in *Isotelus*. The hypostoma figured is thought from the association to belong to *I. angusticaudus*, and its hemispheric body is certainly much like that of the type of the genus.

Isoteloides angusticaudus Raymond.

Plate XVII, figure 7; Plate XVIII, figure 1; Plate XIX, figure 8.

Isotelus angusticaudus RAYMOND, Annals Carnegie Museum, III, 1905, 345, pl. 13, figs. 3, 4.

An entire specimen and a good cephalon of this species were obtained by Professor Perkins. The species was originally described from the pygidium.

DESCRIPTION.

Entire animal oval, somewhat pointed at the extremities, about twice as long as broad. Body compressed, strongly convex; shell finely punctate.

Cephalon about three-quarters as long as wide, strongly convex, depressed and rather pointed at the anterior margin. Eyes large, about their own width from the posterior margin. Glabella nearly smooth, the cast showing two pairs of very faint furrows. Genal angles rounded, without spines. The neck-furrow is slightly impressed, and in front of it is a small median pustule.

Thorax of eight segments. Axial lobe rather broad for this genus; pleura abruptly deflected.

Pygidium narrow, strongly and uniformly convex, tapering rapidly. Sides nearly straight, the margin slightly concave and very steep; axial lobe not strongly defined, wide at the anterior end, but tapering rapidly. In the cast there are traces of annulations on the axis and faint indications of ribs on the pleura.

The entire specimen is 58 mm. long, and 27 mm. wide. One pygidium is 18 mm. long and 19 mm. wide, while a large one is 35 mm. long and 36 mm. wide. A large cephalon is 35 mm. long and 50 mm. wide.

This species differs from all other *Asaphidæ* in the Chazy in its long narrow form. It is very closely related to *Isoteloides homalnotoides* (Walcott) of the Trenton, but that species seems to have a more strongly defined glabella and smaller eyes.

Locality.—*Isoteloides angusticaudus* is a rare fossil on Valcour Island, New York, but is common in the buff dolomite of the reef on Isle La Motte, Vermont.

Subfamily *OGYGINÆ* nov.

Genus *NILEUS* Dalman.

Nileus perkinsi sp. nov.

Plate XVIII, figures 7, 8.

This species is so far known from only two specimens, one collected by Professor Perkins on Isle La Motte, and the other a specimen from the same locality in the U. S. National Museum.

DESCRIPTION.

Cephalon about three-fourths as long as wide, strongly and evenly convex, sloping gently to the sides without any depressed border. Eyes very large, situated far apart and close to the posterior border of the cephalon. The glabella is not differentiated from the remainder of the cephalon, and is smooth except for a very small median tubercle. The genal angles are not well preserved on either of the specimens at hand, but appear to be regularly rounded and aspinose. The surface of the test is marked by very minute punctæ.

Of the thorax only five segments are preserved. It is strongly convex and dorsal furrows appear to be absent. The pygidium is as yet unknown.

This species differs from *Nileus vigilans* (Meek and Worthen) as described by Clarke from Minnesota in several particulars, but principally in respect to the eyes, which are much larger and farther back in our species. The species from the Chazy is much more closely allied to *Nileus scrutator* Billings, but differs from that species in having the cephalon longer in proportion to the width. One of the cephalons of *Nileus perkinsi* is 25 mm. long and 35 mm. wide, while Billings gives the measurements of one of his specimens as 9 lines long and 17 lines wide. According to Billings' figure the anterior portion of the cephalon of *N. scrutator* is abruptly incurved, while the axial portion of the cephalon of the species here described is almost flat. Both *Nileus macrops* Billings and *N. affinis* Billings have eyes much larger and placed further forward than in our species.³

Locality.—Both specimens are from the buff dolomite at the base of the upper Chazy on Isle La Motte, Vermont. The species is named for Professor George H. Perkins, the eminent State Geologist of Vermont.

³Paleozoic Fossils of Canada, Vol. I, pp. 273-275, figs. 259-261, and Paleontology of Minnesota, Vol. III, pt. II, p. 712, figs. 17-19.

Subgenus *VOGDESIA* nov.

Vogdesia bearsi Raymond.

Plate XIX, figures 10-12.

Isotelus ? bearsi RAYMOND, Annals Carnegie Museum, III, 1905, 345, pl. 10, figs. 21-24, not 25.

Material collected since the publication of my previous paper makes it possible to place this species more satisfactorily than was done at that time. A few thoracic segments which appear to belong to this species have been found. They show an extremely wide axial lobe, and the dorsal furrows are very shallow. The thorax is thus similar to that of *Nileus*, as is the pygidium. The cephalon, which is short and broad, is also similar to that of *Nileus*, but differs from it in having smaller and much more elevated eyes and deeper dorsal furrows. In these particulars it is sufficiently different from *Nileus* to be put in a separate subgenus, of which it is the type.

DESCRIPTION.

Cephalon broad, flattened on top, with abruptly rounded slopes. Glabella slightly convex, extending to the frontal margin, which is abruptly incurved. Between the glabella and the free cheeks are quite deep dorsal furrows. The lobation of the glabella is very obscure, four pairs of very faint furrows being visible on small specimens. Some of the exfoliated specimens show a very faint median tubercle which is situated back of the eyes as in *Asaphus*, not between them as in *Nileus* and *Symphysurus*.

The eyes are far apart and project high above the general level of the head. They are situated a little behind the middle of the cephalon. The genal angles are rounded.

The thorax is known only from isolated segments. The axial lobe is very wide, and the dorsal furrows only slightly impressed. Pygidium rounded in outline, gently convex, the axial lobe almost obsolete. Around the posterior end is a rather wide depressed margin.

Nileus vigilans (Meek and Worthen) is another species which belongs to this subgenus. It has small eyes, and a faint median tubercle back of them. Clarke (Paleontology of Minnesota, Vol. III, pt. II, p. 713) has already pointed out that that species is not a typical *Nileus*, differing from *Nileus armadillo* and *N. palpebrosus* in having smaller eyes. Dr. Clarke considers the smaller and higher eyes as the accompaniment of phyletic maturity in the group, and states that another name "might be useful as indicating the different state of development attained by these later forms."

The name *Vogdesia* is given in acknowledgment of the debt which students of the trilobites owe to Brig. Gen. A. W. Vogdes for his work on the bibliography of the subject.

Family ILLÆNIDÆ.

Genus ILLÆNUS Dalman.

Subgenus THALEOPS Conrad.

Thaleops arctura (Hall).

Illænus arcturus HALL, Paleontology of New York, I, 1847, 23, pl. 4bis, fig. 12. — EMMONS, American Geology, I, ii, 1855, 235, pl. 3, fig. 12. — BILLINGS, Canadian Naturalist and Geologist, IV, 1859, 379.

Illænus ovatus RAYMOND, Bulletin American Paleontology, III, 1902, pl. 18, fig. 9.

Thaleops ovata RAYMOND, Annals Carnegie Museum, III, 1905, 352, pl. 13, fig. 5.

Thaleops arctura RAYMOND and NARRAWAY, Annals Carnegie Museum, IV, 1908, 248, pl. 61, fig. 8.

Thaleops arctura and *T. ovata* were united as one species in my paper of 1905, but later it was found by Mr. Narraway and myself that *T. arctura* had longer and more angular genal spines and more elevated eye-stalks than *T. ovata*.

Subgenus BUMASTUS Murchison.

Bumastus globosus (Billings).

Plate XIX, figure 9.

On account of its broad axial lobe this common species is referred to *Bumastus*.

Bumastus erastusi Raymond.

Illænus erastusi RAYMOND, Annals Carnegie Museum, III, 1905, 351, pl. 13, figs. 8, 9.

This species, which is quite common in the reefs at Valcour Island, was found by Professor Perkins to be extremely abundant at the same horizon on Isle La Motte.

Bumastus limbatus sp. nov.

Illænus indeterminatus RAYMOND, (*non* WALCOTT), Annals Carnegie Museum, III, 1905, 347, pl. 13, figs. 1, 2.

This species was first described as *Illænis indeterminatus*, a species which had never been adequately figured, but when Mr. Narraway sent specimens of the real *Bumastus indeterminatus* from the Black River, it was at once seen that there were important differences between the two species. The dorsal furrows of *B. limbatus* are much less arcuate than

those of *B. indeterminatus*, and the genal angles of the latter species are rounded, while the free cheeks of the former are drawn out into broad spines.

Family LICHADIDÆ Barrande.

Genus LICHAS Dalman.

Subgenus AMPHILICHAS Raymond.

Amphilichas minganensis (Billings).

Plate XVIII, figure 6; Plate XIX, figures 13, 14.

The name *Platymetopus* given to this subgenus by Angelin being pre-occupied, Professor Reed suggested *Paralichas* to replace it. That name also having been used previously, the writer suggested *Amphilichas*.⁴

Among the specimens collected by Professor Perkins on Isle La Motte is one retaining one of the eyes. The eye is large, and the visual area occupies a semi-circle, giving a large range of vision.

It is to be noted that all the pygidia so far found in the Chazy are of the type with two complete rings on the axial lobe, three pairs of pleural segments with free ends, and a pointed, triangular axial lobe. Similar pygidia found in Russia are assigned by Schmidt to *Metalichas cicatricosus*, while the pygidium assigned by him to *Amphilichas lineatus* does not have a pointed axial lobe and the two median pleural segments are more or less coalesced. It can hardly be doubted that the cranidia and pygidia found associated in the Chazy belong to the same genus and species, and it is equally unlikely that Schmidt was mistaken in associating the cranidia and pygidia which he referred to *A. lineatus*. The glabella of *Amphilichas* is one which might have been developed along parallel lines in different sections of the *Lichadidæ*, and it is therefore possible that our American species is not congeneric with *Amphilichas lineatus*. Reed finds an association of parts in *Lichas hibernicus* Portlock similar to that in the American species, and, following Schmidt, he at one time referred the thorax and pygidium originally described by Portlock to *Metalichas*, and the associated cranidia to a new species of *Amphilichas*.⁵ In a more recent paper, however, he returns to the older association, and refers both parts to *Amphilichas*.⁶

From the locality at McCullough's sugar-bush which has proved so prolific in small trilobites a number of small specimens of an *Amphilichas* have been obtained. On account of their uniformly small size it is

⁴*American Journal of Science*, Series 4, XIX, 1905, 377.

⁵*Quarterly Journal Geological Society London*, LVIII, 1902, 74.

⁶*Paleontographical Society*, 1906, 106.

thought that they are the young of *Amphilichas minganensis*, although a typical example of that species has never been found with them. The glabellar furrows of these specimens do not extend back to the neck-ring as in *Amphilichas minganensis*, but die out a short distance in front of it. At their posterior ends they turn slightly outward, ending in a sort of pit. In one specimen there is another pit on each furrow about halfway between the posterior end of the furrow and the frontal border. These pits are probably the remnants of the inner portions of the second and third pairs of glabellar furrows, and the development of the glabella seems to have been similar to that of the *Encrinuridae* and *Acidaspidæ*. Reed has shown that in the section of the *Lichadidae* to which *Amphilichas* belongs the side lobes are the fused, second, third, and fourth glabellar lobes, and that the glabellar furrows are the first pair prolonged by the uniting of the inner ends of all three pairs of furrows. The anterior portion of a glabellar furrow, back to the first pit shown on these small specimens, would be interpreted as the original first glabellar furrow. As the animal grew, the muscular attachment became localized in one point, the inner end of each furrow. The shell being thin, the side lobes bulged, obliterating most of the furrow, and a secondary furrow was produced, connecting the inner ends of the original furrows with the anterior furrow. That the glabellar furrows originated in this way is shown by the fact that in the adult they are not straight, but there is a slight off-set marking the position of each of the pits seen on these immature specimens. According to this theory of the development of the glabella, the uniting of the ends of the furrows proceeding from the front backward, the specimens here discussed might represent a step either in the ontogeny or the phylogeny. As they are all small, it is most probable that they are immature individuals.

Reed has described as *Amphilichas* sp. a large cranidium from the Llandeilo of Girvan which has glabellar furrows which die out before the neck-furrow is reached,⁷ and the same character is seen in some specimens of *Amphilichas lineatus* (Angelin).⁸

Family ACIDASPIDÆ Barrande.

Genus CERATOCEPHALA Warder.

Ceratocephala narrawayi sp. nov.

Plate XVIII, figure 5; Plate XIX, figure 15.

In a fragment of limestone from the middle Chazy at Chazy, New York, was found a minute glabella of a species of *Ceratocephala*. This is of

⁷*Paleontographical Society*, 1906, 109, pl. 15, figs. 4, 5.

⁸Revision der Ostbaltischen Silurischen Trilobiten, II, 1885, pl. 6, fig. 5.

particular interest as it is the only representative of this genus as yet definitely known from the American Ordovician. This specimen belongs to a species very closely related to *Ceratocephala coalescens* van Ingen, a species found in the Silurian limestone at St. Clair Spring, near Batesville, Arkansas.⁹ The glabella here described differs from that of *C. coalescens* in being slightly shorter and wider, and in having the surface covered with minute granules instead of being smooth.

DESCRIPTION.

Cranidium, disregarding the spines, nearly circular in outline, slightly and regularly convex, surface granulose. The second pair of glabellar furrows turn backward parallel to the axis and divide it into three longitudinal ridges, the central one large, expanding toward the front, and reaching nearly to the anterior margin. The side lobes are small, reniform, the third pair of furrows being represented only by pits, so that the second and third lobes are coalescent. The fixed cheeks are small and convex. The suture cutting close to the glabella. The neck-furrow is narrow and deep, and the neck-ring wide. The ring bears two widely divergent spines whose bases are separated. There are also two lateral pustules and a median pustule on the upper surface of the ring.

The cranidium, without the spines, is 1.5 mm. long, and the more perfect spine is of about the same length.

Locality.—The specimen is from McCullough's sugar-bush at Chazy, New York, and is in the Carnegie Museum. The name is in honor of Mr. J. E. Narryway, who has obtained many new and rare trilobites from the vicinity of Ottawa.

Genus GLAPHURUS Raymond.

Glaphurus pustulatus (Walcott).

Plate XVIII, figures 9-11.

One of the specimens found by Professor Perkins on Isle La Motte is the largest and finest ever obtained, and it is the only one now known which retains the free cheeks in position. The course of the suture as shown by this specimen indicates that the species belongs to the *Acidaspidæ*, but the remainder of the animal is so different from other members of the family that it seems best to elevate *Glaphurus* to generic rank, rather than to consider it as a subgenus as was done in my previous paper.

⁹*School of Mines Quarterly*, XXIII, 1901, 48, fig. 11.

ORDER *Proparia* Beecher.

Family ENCRINURIDÆ Linnarsson.

Genus CYBELE Loven.

Cybele prima Raymond.

Plate XIX, figure 19.

Glaphurus primus RAYMOND, Annals Carnegie Museum, III, 1905, 362, pl. 14, figs. 6, 7.*Cybele valcourensis* RAYMOND, *ibidem*, 1905, 362, pl. 14, fig. 9.*Cybele prima* NARRAWAY and RAYMOND, *ibidem*, 1906, 601.

The writer has already explained how he was led to describe the cranidia and free cheeks of this species as a species of *Glaphurus*, and how the fortunate discovery of a nearly complete specimen of *Cybele ella* by Mr. Narraway gave us our first knowledge of the glabella of an American species of this genus.

Family CERAURIDÆ.

Genus PLIOMERA Angelin.

Subgenus PLIOMEROPS Raymond.

Pliomerops canadensis (Billings).

Plate XVIII, figure 14.

Pliomera fischeri, the type of the genus, differs from nearly all other species usually referred to *Pliomera* (*Amphion* of most authors), in having

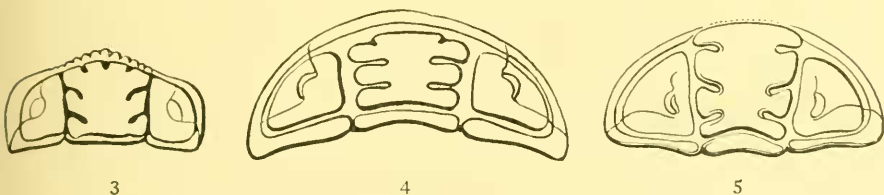


FIG. 3. *Pliomera fischeri* (Eichwald). Cephalon, showing median furrow and denticulate border. After Brogger.

FIG. 4. *Pliomerops canadensis* (Billings) Cephalon. From specimen in Carnegie Museum.

FIG. 5. *Pliomerops pseudoraticulatus* (Portlock). Cephalon. After Salter.

a median indentation or furrow in the front of the glabella. The cephalon of that species also has a denticulate frontal border, while the other species have smooth borders. For these reasons the writer has suggested

a new subgenus with *Amphion canadensis* as the type.¹⁰ *Amphion pseudo-articulatus* Portlock, *A. benevolens* Salter, *A. senilis* Barrande, and possibly *A. westoni* Billings, *A. nevadensis* Walcott, and *A. barrandei* Billings,

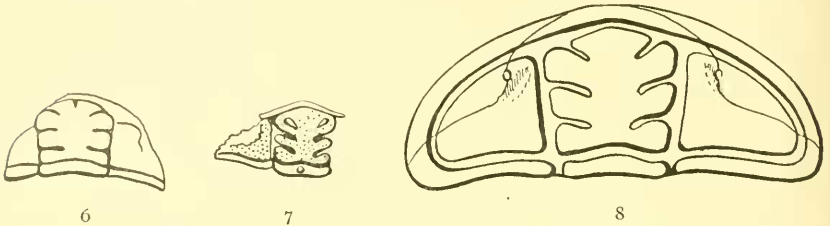


FIG. 6. *Pliomerops canadensis* (Billings). Copy of Billings' figure, twice natural size. On the specimen, which is now before the writer, the median furrow is so faint that it can hardly be seen. It is not present on mature specimens.

FIG. 7. *Pliomerops barrandei* (Billings). Copy of Billings' figure.

FIG. 8. *Pliomerops senilis* (Barrande). After Barrande.

belong to this subgenus. This last species has a peculiar glabella, the median furrow showing on the cast and the first lateral furrows being represented by pits.

Genus CERAURUS Green.

Subgenus NIESZKOWSKIA Schmidt.

Nieszowskia sp. ind.

Plate XVIII, figure 13; Plate XIX, figure 20.

A single pygidium which probably belongs to one of the described species of this genus has been found at Chazy. The axial lobe shows two narrow convex rings which extend across its full width, and back of them a ring which has so fused with the terminal triangular segment as to produce a circular ridge. Within the circle so formed is the remnant of another segment, forming a small hemispheric mound. The pleura consist of two pairs of segments with free terminations.

Locality.—McCullough's sugar-bush, Chazy, New York. No cranidia of *Nieszowskia* have yet been found at this locality.

¹⁰*American Journal of Science*, Series 4, XIX, 1905, 377. In designating *A. canadensis* as the type it is to be understood that the species described under that name in my paper of 1905 is meant. Billings figured and described as the type of this species a small specimen with a furrow in the front of the glabella. This is an immature individual, retaining this during the early stages of the ontogeny only.

Subgenus HELIOMERA Raymond.

Heliomera sol (Billings).

Plate XVIII, figure 12.

Cheirurus sol BILLINGS, Paleozoic Fossils of Canada, I, 1865, 288, fig. 276.*Heliomera sol* RAYMOND, American Journal of Science, series 4, XX, 1905, 381.

DESCRIPTION.

Cephalon short, wide, the glabella very large and flattened, the cheeks small. Glabella almost semicircular, with three pairs of long narrow glabellar furrows, all of which turn backward on their inner ends, each joining the one back of it, and the third pair joining the neck-furrow, thus

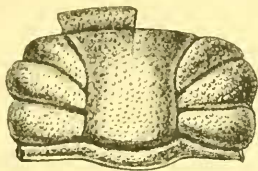


FIG. 9. *Heliomera sol* (Billings). Glabella and fragments of frontal border, $\times 4$.

producing a central lobe like that of *Amphilichas*. This central lobe is of uniform width up to the inner ends of the first pair of glabellar furrows, but expands suddenly in front of them. Toward the front of the median lobe there is a slight depression, suggesting the median furrow in *Pliomera*. The first pair of glabellar furrows run backward at an angle of about 45° , the second pair at a smaller angle, while the third pair are nearly parallel to the neck-furrow. The glabellar lobes are narrow and club-shaped. The neck-ring is wide, flat, and separated from the glabella by a deep furrow which extends the whole width of the cephalon. The cheeks are not sufficiently well preserved to be described, but enough of the test remains to show that the outline of the cephalon was similar to that of *Pseudosphærexochus vulcanus*. There is a narrow smooth border all around the front, and the surface of the glabella is covered with fine tubercles.

The relations of this species are rather doubtful. From the form of the cephalon it seems to belong close to *Pseudosphærexochus*, but there has not been seen in any of the species of that subgenus a tendency to vary in the direction of an isolated central lobe and long isolated glabellar lobes. The glabellar furrows in the various species are usually faint, never deeply

impressed as in this species. In this last character and the presence of a median depression on the frontal lobe it resembles *Pliomera*. It was for trilobites of this type of glabellar structure that the name *Heliomera* was proposed, with *Cheirurus sol* Billings as the type.

Locality.—Upper part of the lower Chazy at Chazy, New York. The plesiotype is in the Museum of Yale University. The original specimens described by Billings were from Table Head and near Portland Creek, Newfoundland.

Genus SPHÆROCORYPHE Angelin.

Sphærocoryphe goodnovi Raymond.

Plate XIX, figures 16-18.

Since this species was published more material has been obtained, which makes it possible to give somewhat better figures. The genal angles are found to bear long, round, slightly curved spines.

EXPLANATION OF PLATES.

Unless otherwise indicated, figures are natural size, and the specimens are in the Carnegie Museum.

PLATE XVII.

1. *Isotelus harrisi* Raymond. A cranidium from Isle La Motte, now in the Vermont State Museum.
2. *Isotelus platymarginatus* Raymond. A cast taken from the natural mould shown in figure 3.
3. The same species. A natural mould from Isle La Motte, Vermont. Vermont State Museum.
4. The same species. A large pygidium from Acidaspis Point, Valcour Island, New York.
5. The same species. A free cheek from the lower part of the Chazy at the southern end of Valcour Island. About three times natural size.
6. *Basilicus marginalis* (Hall). A large pygidium showing the peculiar notch in the posterior margin. Sloop Bay, Valcour Island, New York. Yale University Museum.
7. *Isotelooides angusticaudus* Raymond. A cephalon from Isle La Motte, Vermont. Vermont State Museum.

PLATE XVIII.

1. *Isotelooides angusticaudus* Raymond. An entire, but imperfect specimen from Isle La Motte. Slightly larger than natural size. Vermont State Museum.
2. *Onchomelopus obtusus* (Hall). Cephalon and thorax of an enrolled individual in the Vermont State Museum. From Isle La Motte, Vermont.
3. The same specimen. Thorax and pygidium.
4. The same species. A pygidium from Valcour Island showing the large punctæ of the shell.

5. *Ceratocephala narrawayi* Raymond. The cranidium of the only specimen known. From McCullough's sugar-bush at Chazy, New York. About three and one-half times natural size.
6. *Amphilichas minganensis* (Billings). A young individual whose dorsal furrows do not reach the neck-furrow. About three and one-half times natural size. From McCullough's sugar-bush at Chazy, New York.
7. *Nileus perkinsi* Raymond. The cephalon and part of thorax. This specimen is from Isle La Motte, and is now in the Vermont State Museum. Holotype.
8. *Nileus perkinsi* Raymond. Paratype in the U. S. National Museum. From Isle La Motte, Vermont.
9. *Glaphurus pustulatus* (Walcott). A photograph of one of the specimens figured in my previous paper. From Chazy, New York.
10. The same species. A large entire specimen from Isle La Motte, Vermont. Vermont State Museum.
11. The same species. Another of the specimens figured in my previous article.
12. *Helimera sol* (Billings). A glabella from the lower part of the Chazy at Chazy, New York. About three and one-half times natural size. Yale University Museum.
13. *Nieszkowskia* sp. A pygidium from McCullough's sugar-bush at Chazy, New York. About three and one-half times natural size.
14. *Pliomerops canadensis* (Billings). A small specimen from Valcour Island, New York.

PLATE XIX.

1. *Basilicus marginalis* (Hall). A very small and somewhat imperfect cranidium from McCullough's sugar-bush at Chazy, New York. $\times 4$.
2. The same species. A pygidium from the same locality. $\times 4$.
3. *Isotelus platymarginatus* Raymond. A drawing made from the cast of the natural mold shown in figure 3, Plate XVII. $\times 2$.
4. *Isotelus beta* Raymond. A pygidium. $\times 2$.
5. The same species. Pygidium and one thoracic segment. $\times 2$.
- 6, 7. The same species. Two free cheeks. $\times 2$. 4 to 7 are from specimens collected at Chazy, New York.
8. *Isoteloides angusticaudus* Raymond. Hypostoma found associated with, and supposed to belong to this species. Natural size.
9. *Bumastus globosus* (Billings). Hypostoma supposed to belong to this species. Natural size. Valcour, New York.
10. *Vogdesia bearsi* Raymond. A small pygidium. Natural size.
11. The same species. Side view of a free cheek and eye. Natural size.
12. The same species. A pygidium, natural size. 10, 11, 12 are from specimens collected at Sloop Bay, Valcour Island.
13. *Amphilichas minganensis* (Billings). Part of the pleuron of a thoracic segment. $\times 2$.
14. The same species. A small imperfect cranidium with dorsal furrows which do not meet the neck-ring. $\times 4$.
15. *Ceratocephala narrawayi* Raymond. The cranidium of the holotype. $\times 4$.
16. *Spharocoryphe goodnori* Raymond. A cephalon. $\times 4$.



17. The same species. A free cheek. $\times 4$.
18. The same species. A glabella. $\times 4$.
19. *Cybele prima* Raymond. A glabella. $\times 4$.
20. *Nieszkowskia* sp. A pygidium. $\times 4$.
21. *Nieszkowskia* or *Pseudospherexochus*. Hypostoma supposed to belong to one of these genera. $\times 2$.
22. A large hypostoma belonging to one of the *Cerauridae*, but too large to belong to any of the known species in the Chazy. Natural size. From Cooperville, New York.